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REFINEMENT OF THE TECHNOLOGY FOR GLAZING SANITARY WARE

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The compositions of raw glazes used at the Ceramic Product Works (Ekaterinburg) and in some European countries for glazing sanitary ware are analyzed. The reasons for the appearance of dullness in a glaze coating and methods for its prevention are considered.

Over 1989 – 1994 the composition of raw glaze for sanitary ware at the Ceramic Product Works (Ekaterinburg) varied significantly (Table 1).

The main defect during this period was glaze dullness. For several years, attempts were made to eliminate this defect by increasing the amount of flux (Chupinskoe pegmatite) from 36.4 to 43.3%, but the expected result was not accomplished. The dullness of the glaze would unexpectedly appear and just as unexpectedly disappear 1 – 2 times a month. When regular chemical analysis of the glaze was implemented, it was found that in milling of zircon for 120 h, a substantial amount of alumina from the mill balls is milled as well. As a result, the total content of Al_2O_3 in the glaze was 4 – 5% higher than the calculated value, which caused the effect of dullness. When for some reason the number of balls in the mill for zircon was insufficient, the glaze coating was produced lustrous.

Accordingly, to prevent dullness, it was necessary to modify the formula so as to decrease the Al_2O_3 content. For this purpose, glaze formulas from several Italian and German producers received from Nassetti (Italy) specialists were analyzed (Table 2).

Taking into account the available raw materials at the Ceramic Products Works and the experimental-research results, a glaze composition was developed that makes it possible to prevent dullness and obtain a lustrous glaze.

Another goal of the factory technologists was to obtain a snow-white glaze coating with a degree of whiteness comparable to similar Italian products. Since the effect of whiteness is produced by finely milled zircon, in production of premium products (the Alfa set) domestic zircon material was replaced by finely milled zircosil (72% ZrO_2) or zircobite (66% ZrO_2) of grade MO produced in Italy. To obtain a pure white color in artificial lighting, cobalt sulfate was additionally introduced into the glaze composition.

The final glaze composition is as follows (%): 37.5 Chupinskoe pegmatite, 24.0 Ul'yanovskoe sand, 17.0 separated chalk, 5.0 zinc white, 11.0 zircosil (zircobite), 0.5 barium carbonate, 1.0 – 2.0 DN-1 clay, 3.0 Glukhovetskoe kaolin (milled and concentrated), 0.015 cobalt sulfate, and 0.05 peptaton 52 (peptaton 52 is a glue produced by Zchimmer und Schwartz GmbH (German), which facilitates fixation of the coating applied to the product). The glue introduced into the glaze makes it stronger and prevents its damage in transporting and placing articles in a furnace. Peptapon 52 can be replaced by ordinary sodium carboxylmethyl cellulose, but then the amount of adhesive material should be increased to

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TABLE 1

Years	Glaze composition, %										
	Chupinskoe pegmatite	Ul'yanovskoe sand	separated chalk	milled zircon	barium carbonate	zinc oxide	DN-0 clay	Glukhovetskoe kaolin (milled,concentrated)	cobalt sulfate	sodium carboxymethyl cellulose	common salt
1989 – 1991	36.4	20.5	11.0	16.5	5.5	4.2	3.4	2.5	0.03	0.01	0.05
1992	39.0	21.0	11.0	14.0	5.0	4.0	3.4	4.5	0.025	–	–
1993	42.0	20.0	10.0	14.5	4.3	3.9	3.4	2.5	–	–	–
1994	43.3	18.9	8.4	14.5	4.3	3.8	4.1	2.8	–	–	–

TABLE 2

Country	Glaze composition, %												
	feldspar	quartz	chalk	dolomite	wollastonite	zinc oxide	zirconium silicate	barium carbonate	talc	kaolin	clay	water	deflocculant
Italy:													
composition 1	38.0	14.0	7.0	–	12.0	2.0	6.0	4.0	2.0	15.0	–	42.0	0.1
composition 2	40.0	22.0	7.0	3.0	8.0	1.0	9.0	–	–	10.0	–	42.0	0.1
composition 3	30.0	30.0	15.0	–	–	2.0	10.0	2.0	–	11.0	–	42.0	–
Germany	38.0	24.0	9.5	8.0	–	5.0	10.0	0.5	–	–	5.0	42.0	–

1.5%, i.e., 30-fold. A special feature of the glue is that is cannot be introduced into the mill in milling. The glue is first soaked in water for one day and then dissolved in the glaze, employing a high-speed mixer. In addition to the adhesive capacity, the glue has electrolytic properties. If this is not sufficient, the usual electrolyte, namely, soluble glass, is added to the glaze.

Prior to 1997, all sanitary ware at the factory was glazed by immersion, with subsequent supplementary glazing, using a paint sprayer. The glaze density in immersion was 1.53 g/cm^3, and in supplementary glazing it was 1.60 – 1.61 g/cm^3.

Products glazed in that way were excessively saturated with water and took a long time drying, the coating was produced too thin, and the crock showed through the coating. In addition, the article had numerous drips.

It proved possible to diminish these drawbacks by increasing the pycnometric density to 1.61 g/cm^3 in glazing by immersion, while the areometric density was 1.68 – 1.70 g/cm^3. The pycnometric density was raised to 1.67 – 1.68 g/cm^3 in supplementary glazing. A further increase in the glaze density proved to be inadvisable, since it was difficult to immerse articles in a suspension of such density. However, the appearance of drips could not be prevented.

In 1997, production of the premium product brand Alfa was started at the factory, and glaze dripping inevitably arising in glazing by immersion became inadmissible. Therefore, these articles had to be glazed by aerography. The glaze prepared for aerography had a density of 1.75 – 1.80 g/cm^3 and a viscosity equal to 17 – 20 sec according to a Ford viscometer (100 cm^3, hole diameter 4 mm). The glazing was carried out employing paint sprayers produced by DeVilbiss with a JGA-402 NA-C needle, an AV115AC K (AV-115-AC-N-2.8.110) nozzle, and an MB4039 62HD head. The air pressure in the aerograph was 6 atm, and the pressure on the glaze was 4 atm.

It should be noted that the glaze flow properties (viscosity, fluidity, etc.) can vary significantly not only with the deposition method but also with the operator skills. With low-skill operators, the viscosity has to be higher.

When putting a glazed article on a trolley, it is placed on a polyurethane pad or corrugated cardboard, which does not cause yellow discoloration.

Thus, products coated with glaze of the composition developed are not inferior to Italian products in their outward appearance and exceed Finnish and Czech products.